

**AIDA** 2020

# **WP11: Final Report on Transnational Access to Irradiation Facilities**

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# TA facilities offered under WP11

## Irradiation Facilities:

- 11.1: CERN IRRAD & GIF++, Switzerland
  - 24 GeV protons, mixed field, gammas
- 11.2: JSI TRIGA reactor, Slovenia
  - Reactor neutrons, gammas
- 11.3: KIT KAZ, Germany
  - Accelerator protons 23 MeV
- 11.4: UCLouvain CRC, Belgium
  - Accelerator neutrons (NIF), heavy ions (HIF)
- 11.5: UoB MC40 Cyclotron, United Kingdom
  - Accelerator protons 27 MeV

# Resources Usage

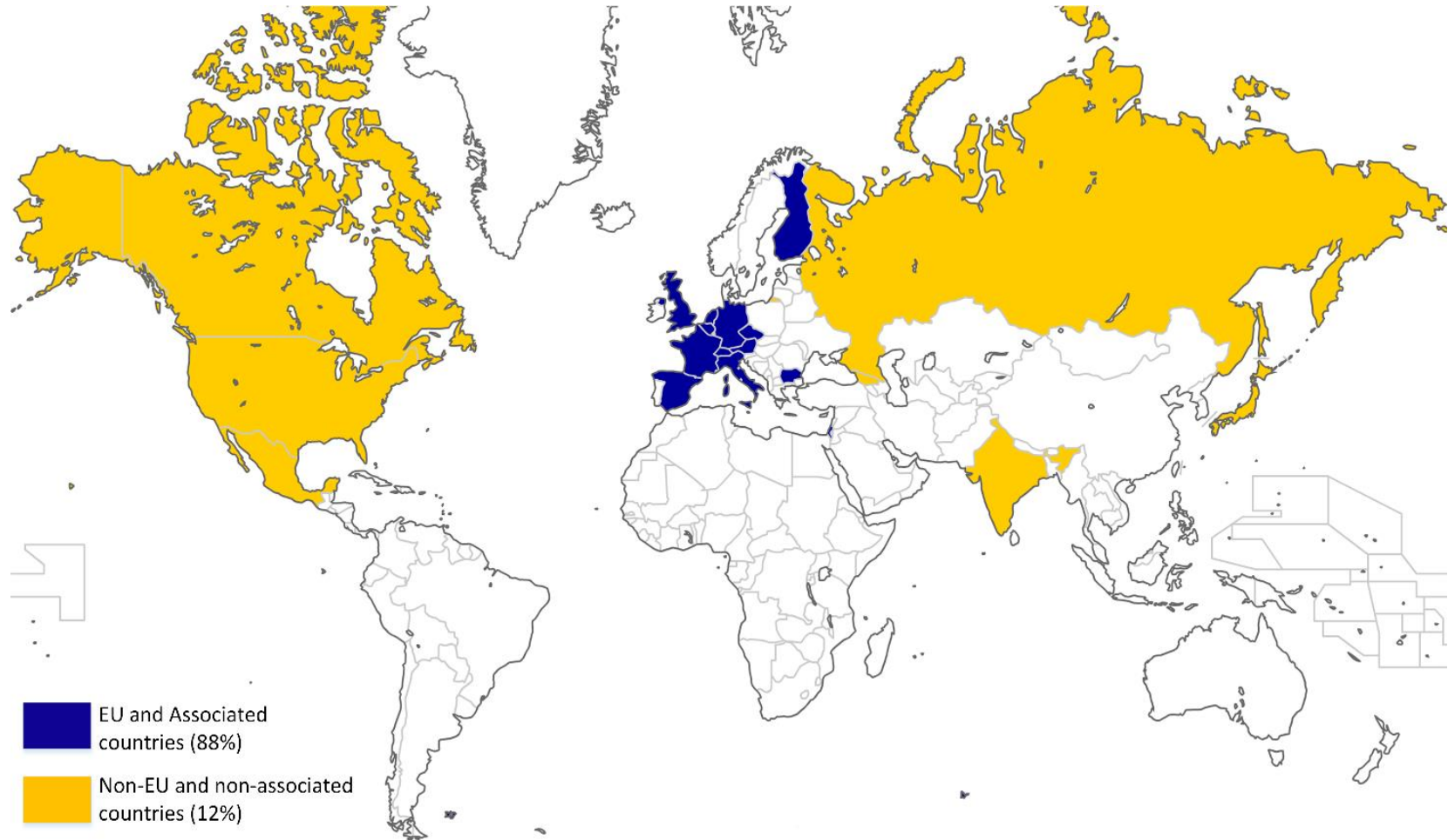
- The only WP11 deliverable: Access Units
  - some of them (CERN) fully covered by institutes budget
  - some (partially) covered by AIDA2020
    - large AU *cost range* (80-850 EUR) due to different cost models and (partial) coverage from other funds
    - AU *budgets* per facility more balanced: 50-125 kEUR
- Two access modes
  - users on site: visits (partially) supported by AIDA2020
    - some irradiations @UCL (SEE)
  - remote access: facilities receive samples and ship them back to users
    - most irradiations
- Deliverable 11.1 submitted this Tuesday
  - Thanks to Alex and Sabrina for compiling the report

# Resources Usage

- All Access Units in WP11 delivered

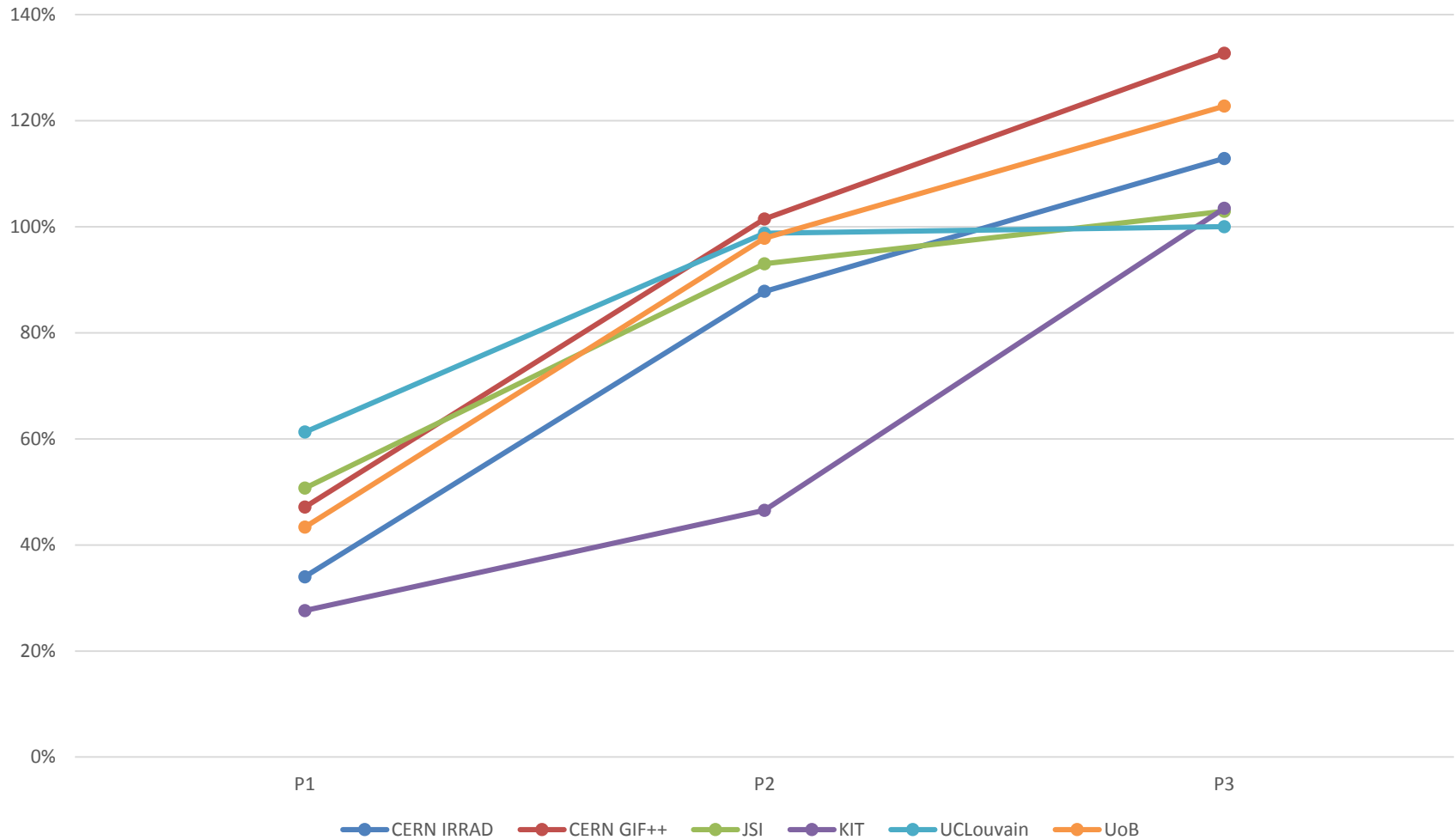
Facility	Number of projects					Number of users					Number of access units				
	P1	P2	P3	Total	Total in Annex1	P1	P2	P3	Total	Total in Annex1	P1	P2	P3	Total	Total in Annex1
CERN IRRAD	5	9	4	18	30	18	39	18	75	60	1370	2170	1010	4550	4032
CERN GIF++	6	7	7	20	20	30	69	25	124	50	1990	2190	1260	5440	4032
JSI	44	44	10	98	50	141	151	26	318	150	253.5	211.5	49.5	514.5	500
KIT	10	10	4	24	30	33	40	20	93	90	27.6	18.93	56.9	103.43	100
UCLouvain	5	3	0	8	10	19	11	0	30	50	49	30	1	80	80
UoB	5	7	1	13	60	14	31	3	48	180	104	130.75	59.75	294.5	240

# Distribution of Users



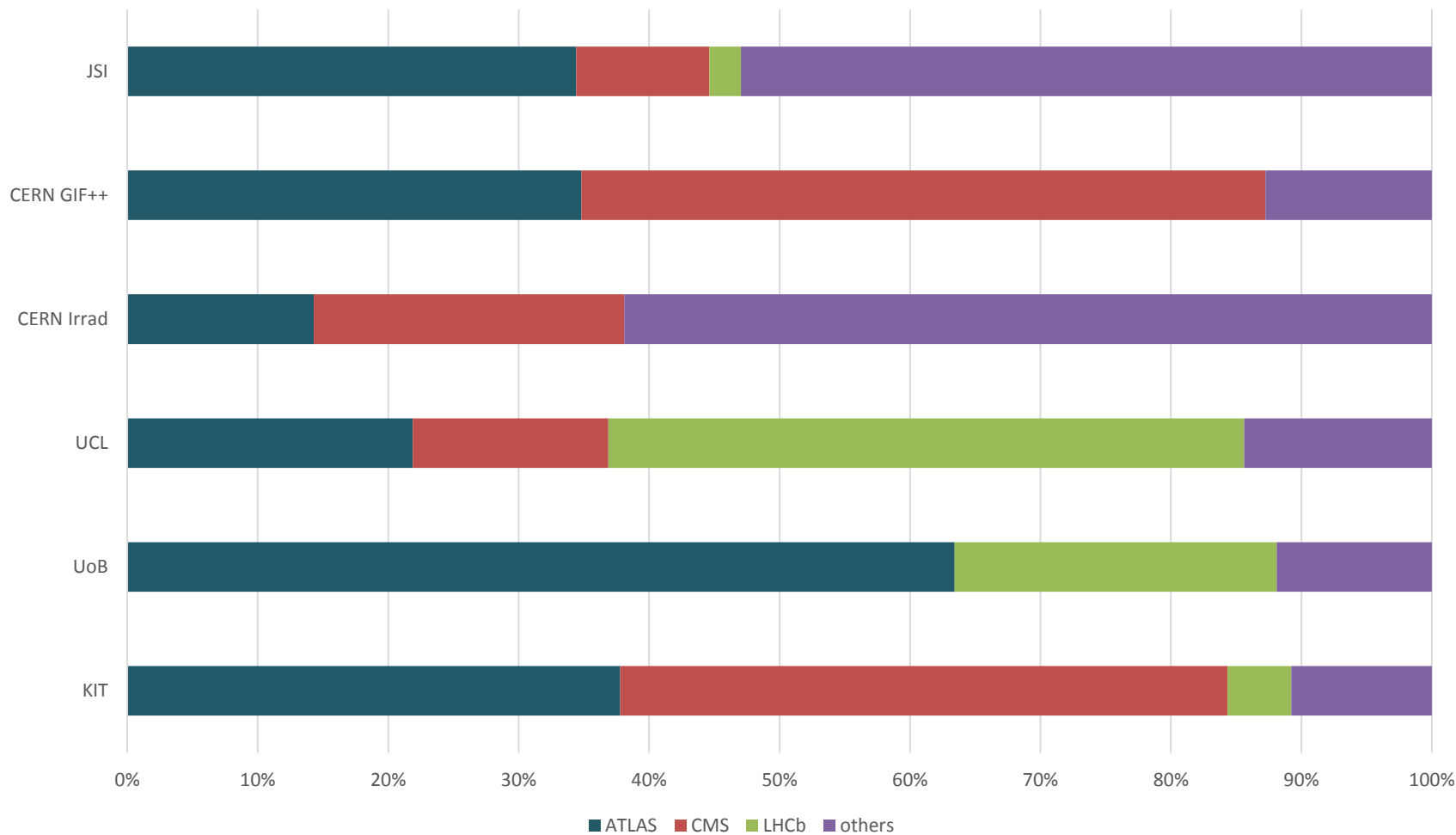
# AU vs. Pledge by Period

Achieved AU per period



# AU per Community

AU per community



# Common Problems

- Number of projects and users somewhat on the low side (not everywhere)
  - people hate filling forms...
- Still hard to trace publications
  - our main scientific output !
  - we have been reminding PI's of their (signed !) duty after finishing TA access...
  - current balance: **77** publications from **181** projects



# Specific Comments on Y5

- CERN: GIF++/IRRAD:
  - used all AU and user support funds
  - IRRAD: LS2 for 2019/20
- JSI:
  - additional 100 AU in Y5 by end 2019 (not accounted)
  - charged AIDA discounted rate for add-on's
- KIT:
  - delivered originally pledged AU during Y5 extension
- UCL:
  - Exhausted pledged AU ~2y ago
  - 20 AU in Y5 at nominal cost for 2 projects (not accounted)
- UoB:
  - Delivered AU in excess of originally pledged (~120 %)

# Summary

- WP11: Transnational Access to Irradiation Facilities in AIDA2020 has delivered all Access Units that the facilities pledged and beyond.  
... a true European success story !

Unlucky enough, no follow-up in AIDAinnova.

# Back-up

# WP11 Reports Focused on Y5

- Solicited input from Facility Leaders
  - Requested 2 slides: Y5, overall
- All responses received
  - Somewhat more than 2 slides/site
- A walk-through the WP11 sites

# 11.1: CERN IRRAD & GIF++



**AIDA** 2020

Status:  
IRRAD Projects



IRRAD  
Proton Facility

## Status of AIDA-2020 projects in IRRAD:

- **18 projects** (5 projects in P1; 9 projects in P2; 4 projects in P3)
- **76 users** (18 users in P1; 39 users in P2; 19 users in P3)
- **4550 units** (1370 units in P1; 2170 units in P2; 1010 units in P3)

P1 = M01-M18

P2 = M19-M36

P3 = M37-M60

### P1

1	CERN-IRRAD-2015-01	Radiation hardness of 65nm IP blocks and CMOS pixels	Alexandre Rozanov, CPPM, Marseille
2	CERN-IRRAD-2015-02	Study of acceptor removal in deep diffused silicon samples	Gianluigi Casse, Liverpool University
3	CERN-IRRAD-2015-03	Proton irradiation of CMS pixel sensors and diodes	Alexandra Junkes, Hamburg University
4	CERN-IRRAD-2015-04	Irradiation of CHESS-1 and HVSTRIP1 chips	Todd Huffman, University of Oxford
5	CERN-IRRAD-2015-05	Characterisation of 3D SINTEF silicon sensors	Ole Rohne, University of Oslo

### P3

15	CERN-IRRAD-2018-01	Radiation hardness of depleted CMOS pixels and 65nm technology	Marlon Barbero, Aix-Marseille University
16	CERN-IRRAD-2018-02	CMS Inner Tracker Sensor irradiation campaign	Ivan Vila, IFCA, Spain
17	CERN-IRRAD-2018-03	Acceptor removal and defects in p-type silicon	Eckhart Fretwurst, Hamburg University
18	CERN-IRRAD-2018-04	Nitrostrip (RD50 project)	Marta Baselga, KIT, Germany

### P2

6	CERN-IRRAD-2016-01	ATLAS Strip module irradiation	Susanne Kuehn, Freiburg University
7	CERN-IRRAD-2016-02	Radiation hardness of 65nm IP blocks and CMOS pixels under radiation for the ITK project	Marlon Barbero, Aix-Marseille University
8	CERN-IRRAD-2016-03	Optical fiber-RCF read-out method	Luigi Campajola, University of Naples Federico II and INFN, Italy
9	CERN-IRRAD-2017-01	Joint ATLAS-CMS INFN R&D on radhard pixel sensors for HL-LHC	Mauro Dinardo, INFN
10	CERN-IRRAD-2017-02	Radiation hardness of depleted CMOS pixels and 65nm technology	Marlon Barbero, Aix-Marseille University
11	CERN-IRRAD-2017-03	Study of LGAD sensors for timing detectors	Rogelio Palomo, University Sevilla, Spain
12	CERN-IRRAD-2017-04	Radiation hardness of TOTEM diamond timing detectors	Tiina Naaranoja
13	CERN-IRRAD-2017-05	Sensor development for the CMS Pixel Phase II	Joern Schwandt, Hamburg
14	CERN-IRRAD-2017-06	CLARO8 radiation hardness test in CERN IRRAD facility	Massimiliano Fiorini

# 11.1: CERN IRRAD & GIF++



**AIDA** 2020

Status: IRRAD



IRRAD  
Proton Facility

- 2019/2020 CERN accelerators are in shutdown (LS2)
- No further proton irradiations in the IRRAD facility since last reporting.
- TA for IRRAD facility is closed

Final status of AIDA-2020 TA projects in IRRAD:

- **18 projects** (60% of anticipated 30 projects)
- **76 users** (127% of anticipated 60 users)
- **4550 units** (113% of aim: 4032 units)

## Conclusion:

- Number of **delivered units in line with proposal value**
- Number of **users higher than anticipated**
- Number of **projects is less than anticipated**
- **Note:** 18 AIDA-2020 projects for the IRRAD facility, which is small compared to the overall irradiations performed in this facility (only fraction of projects filled irradiation request)

# 11.1: CERN IRRAD & GIF++



Status: GIF++



Status of AIDA-2020 projects in GIF++ in April 2019:

- **15 projects** (anticipated: 20 projects)
- **105 users** (anticipated: 50 users)
- **4210 units** (aim: 4032 units)

GIF ++	Projects	Users	Access units
P1 (M1-M18)	6	30	1990
P2 (M19-M36)	7	69	2190
since May 2018 (ongoing)	2	6	30
<b>TOTAL</b>	<b>15</b>	<b>105</b>	<b>4210</b>
<b>Foreseen for project (M1-M48)</b>	<b>20</b>	<b>50</b>	<b>4032</b>

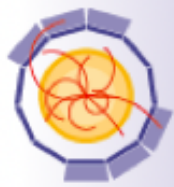
**New since last reporting in 4/2019:  
+3 projects +350 units + 17 users**

<b>P1</b>	1	CERN-GIF-2015-01	RPC for HL-LHC & Studies on new gases	Giulio Aielli (Uni Roma Tor Vergata)
	2	CERN-GIF-2016-01	CERN MicroMegs at GIF++	Paolo Iengo (CERN)
	3	CERN-GIF-2016-02	Validation of high rate large area RPC for Phase-1 LHC	Giulio Aielli (Uni Roma Tor Vergata)
	4	CERN-GIF-2016-03	CMS RPC irradiation test	Gabriella Publiese (Bari University)
	5	CERN-GIF-2016-04	Small Thin Gap Chamber - GIF++	Yan Benhamou (Tel Aviv University)
	6	CERN-GIF-2016-05	Aging test runs of CMS CSC chambers at GIF++	Gennadii Gavrilov (St. Petersburg Nuclear Physics Institute (PNPI), Russia)
<b>P2</b>	4	CERN-GIF-2016-03	CMS RPC irradiation test	Gabriella Publiese (Bari University)
	7	CERN-GIF-2016-06	Fiber optic sensors and dosimeters	Luigi Campajola, Uni Naples
	8	CERN-GIF-2016-07	Online dose rate monitoring system for GIF++	Plamen Iaydjev, (INRNE, Sofia)
	9	CERN-GIF-2017-01	Performance of ATLAS TGC under high background rates	Shikma Bressler (Weizmann Institute of Science)
	10	CERN-GIF-2017-02	CMS-RPC-UPGRADE Irradiation	Gabriella Publiese (Bari University)
	11	CERN-GIF-2017-03	Longevity studies for CMS CSC chambers at GIF++	Gennadii Gavrilov (St. Petersburg Nuclear Physics Institute (PNPI), Russia)
	12	CERN-GIF-2017-04	MPGD at GIF++ for CMS Phase2 upgrade	Luigi Benussi (LNF, ITALY)
	13	CERN-GIF-2017-05	CMS-RPC-IRPC Electronics	Gabriella Publiese (Bari University)
	14	CERN-GIF-2018-01	CMS-RPC-IRPC Longevity	Gabriella Pugliese (Bari University)
	15	CERN-GIF-2019-01	CMS	Barbara Alvarez Gonzalez

## P3

16	CERN-GIF-2019-02	Validation of BIS78 RPC gas gaps for Phase-1 LHC upgrade	Giulio Aielli (INFN and University of Roma Tor Vergata)
17	CERN-GIF-2019-03	Test of the ATLAS BIS78 module0 and 2D readout system for phase 2	Giulio Aielli (INFN and University of Roma Tor Vergata)
18	CERN-GIF-2019-04	Commissioning of a cosmic tracker	Davide Boscherini

# 11.1: CERN IRRAD & GIF++ AIDA<sup>2020</sup>



**AIDA**<sup>2020</sup>

Status: GIF++



Status of AIDA-2020 projects in GIF++ :

- **18 projects** (80% of anticipated 20 projects) [3/2020]
- **122 users** (244% of anticipated 50 users) [3/2020]
- **4560 units** (113% of aim: 4032 units) [3/2020 estimate]

- Irradiations at the GIF++ gamma source (without beam) are ongoing.

## Conclusion:

- Number of **delivered units already passed proposal value** (deliverable)
- Number of **users higher than anticipated**
- Number of **projects is less than anticipated**
- **Some funds are still available for irradiations at the GIF++ gamma source (without particle beam)**



# 11.1: CERN IRRAD & GIF++



AIDA<sup>2020</sup>



AIDA<sup>2020</sup>

Conclusions on TA  
to IRRAD and GIF++

- AIDA-2020 TA resources were used to cover:
  - subsistence of users coming to perform irradiations
  - partial funding of facility personnel (Fellow/Student) to perform irradiations for users not coming to CERN
  
- Long Shutdown 2 at CERN: No more particle beams since last reporting
  - IRRAD facility in shutdown
  - GIF++ facility TA continued with gamma irradiations (without particle beam)
    - Several groups supported to perform irradiations in 2019/20 (4 projects)
  
- Number of delivered units has passed deliverable given in proposal
  - IRRAD: 4550 units delivered (113% of aim: 4032 units)
  - GIF++: 4560 units delivered (113% of aim: 4032 units)
  
- IRRAD and GIF++ TA via AIDA-2020 is a success

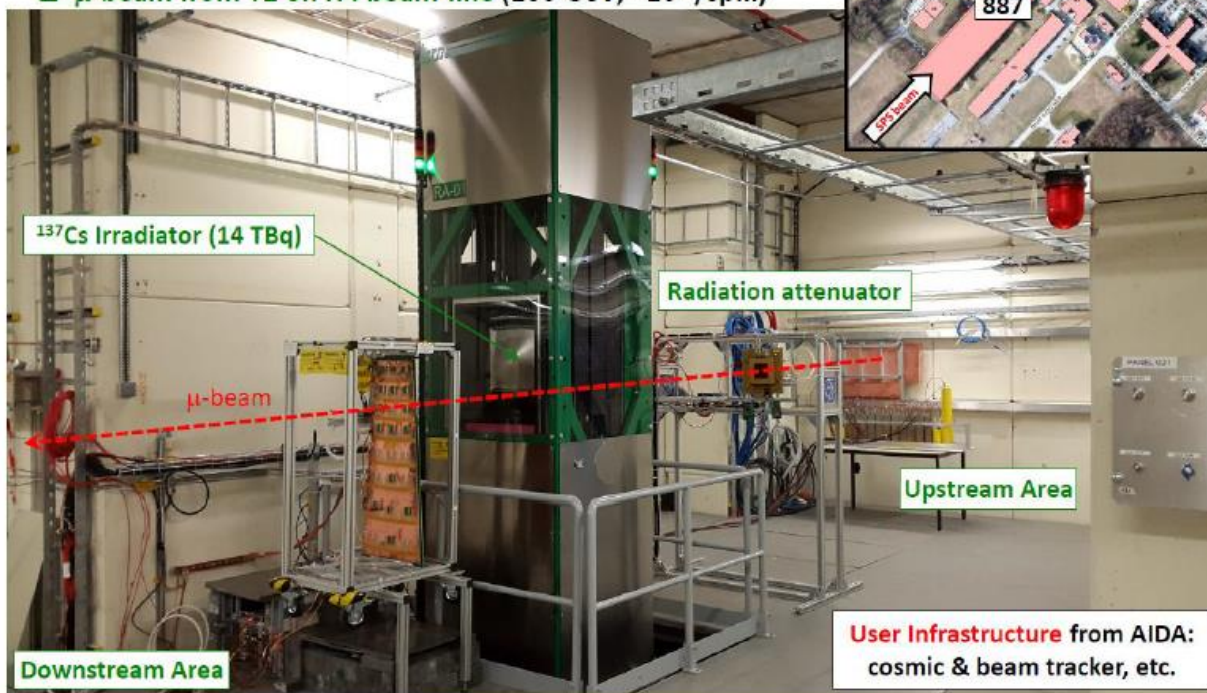
# 11.1: CERN IRRAD & GIF++ AIDA <sup>2020</sup>



## AIDA <sup>2020</sup>

### GIF++ Facility

- $E_\gamma = 0.66 \text{ MeV}$ ; max. dose-rate  $\sim 0.5 \text{ Gy/h @ 1m}$  ( $\pm 37^\circ$  angle)
- Several attenuation factors available (up to  $\sim 50'000$ )
- $\mu$ -beam from T2 on H4 beam-line (100 GeV;  $\sim 10^4$  /spill)



B.Gkotse & M.Moll for IRRAD and GIF++ TA team, AIDA 2020 2nd Annual Meeting, Paris, 4-7.4.2017

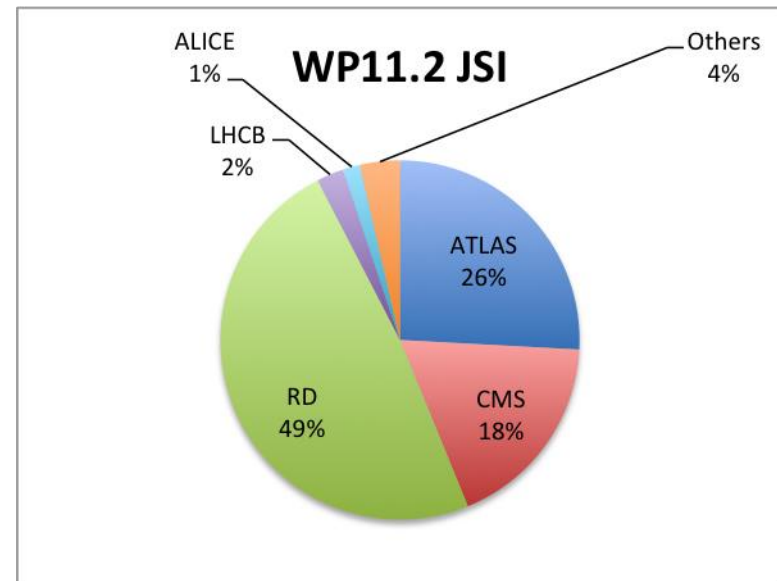
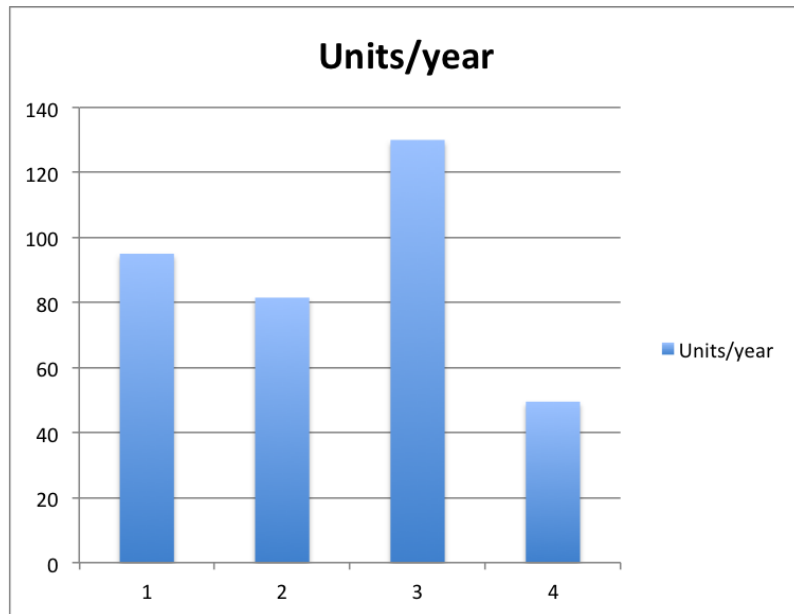
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# 11.2: JSI TRIGA Reactor

Report from one year ago (Oxford meeting):

**514.5** units delivered in 98 projects, approx. 580 irradiations

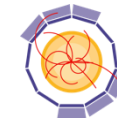
**500** units foreseen in total



# 11.2: JSI TRIGA Reactor

- Irradiations in Y5
  - Demand for irradiations persists
  - 100 access units offered as extension
  - Irradiations for ATLAS collaboration free of charge
  - Other collaborations – half price
  - Fund exhausted by the end of 2019
- The reactor is currently shut down due to the Covid-19 virus

# 11.3: KIT KAZ

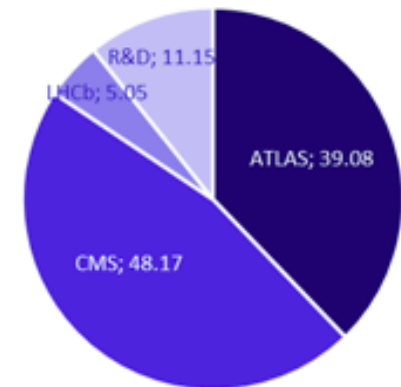


## Status



- Finally, we managed to provide the promised AU after a long technical stop at the cyclotron!
- Access units: **103.45h / 100h**
  - about 3% went to projects from users outside EU (India and Singapore)
- Projects: 24 / 30
- Users: 95 / 90
- We will provide further access to the facility, but need to charge costs to users

AUs per Community



# 11.3: KIT KAZ

## Publications

- Made a last call on 20.3.2020 and got two replies since...
- In total now 19 publications with acknowledgement
- 5/24 projects still without...

AIDA-2020-KIT-2015-1	Folkestad et al.	Development of a silicon bulk radiation damage model for Sentaurus TCAD
AIDA-2020-KIT-2015-2	M. Bomben et al.	Performance of active edge pixel sensors
AIDA-2020-KIT-2015-3	G. Jain et al.	Radiation tolerance study on irradiated AC-coupled, poly-silicon biased, p-on-n silicon strip sensors developed in India
AIDA-2020-KIT-2015-4	A. Starodumov	High rate capability and radiation tolerance of the new CMS pixel detector readout chip PROO600
AIDA-2020-KIT-2015-5		
AIDA-2020-KIT-2016-01, 2016-03	L. Poley	Studies of adhesives and metal contacts on silicon strip sensors for the ATLAS Inner Tracker
AIDA-2020-KIT-2016-02	M. Metzler et al.	Front-side biasing of n-in-p silicon strip detectors
AIDA-2020-KIT-2016-04		
AIDA-2020-KIT-2016-05	J. Lange, S. Grinstead, M. Manna, G. Pellegrini, D. Quirion, S. Terzo, D. Vázquez	
AIDA-2020-KIT-2016-06	Furelos	Radiation hardness of small-pitch 3D pixel sensors up to HL-LHC fluences
AIDA-2020-KIT-2016-07	Folkestad et al.	Development of a silicon bulk radiation damage model for Sentaurus TCAD
AIDA-2020-KIT-2016-08		
AIDA-2020-KIT-2016-09	G. Jain et al.	Radiation tolerance study on irradiated AC-coupled, poly-silicon biased, p-on-n silicon strip sensors developed in India
AIDA-2020-KIT-2016-10	M. Meinhard, M. Backhaus, P. Berger and A. Starodumov	Performance of the modules for layer 1 of the CMS phase I pixel detector upgrade
AIDA-2020-KIT-2017-01	S. Terzo et al.	Characterisation of AMS H35 HV-CMOS monolithic active pixel sensor prototypes for HEP application
AIDA-2020-KIT-2017-02	J. Lange et al.	Radiation hardness of small-pitch 3D pixel sensors up to a fluence of $3 \times 10^{16}$ neq/cm <sup>2</sup>
AIDA-2020-KIT-2017-02	H. Oide et al.	INFN-FBK developments of 3D sensors for High-Luminosity LHC
AIDA-2020-KIT-2017-03	Folkestad et al.	Development of a silicon bulk radiation damage model for Sentaurus TCAD
AIDA-2020-KIT-2017-04	M. Baselga	Update on RD50 project NitroStrip
AIDA-2020-KIT-2018-01, 2015-02	G. Calderini et al.	Active-edge FBK-INFN-LPNHE thin n-on-p pixel sensors for the upgrade of the ATLAS Inner Tracker
AIDA-2020-KIT-2018-01	G. Calderini et al.	Performance of the FBK-INFN-LPNHE thin active edge pixel detectors for the upgrade of the ATLAS Inner Tracker
AIDA-2020-KIT-2018-02		
AIDA-2020-KIT-2018-03		
AIDA-2020-KIT-2018-04	S. Terzo et al.	Performance of Irradiated RD53A 3D Pixel Sensors
AIDA-2020-KIT-2018-05	A. Macchiolo	Characterization of RD53A compatible n-in-p planar pixel sensors
AIDA-2020-KIT-2018-06	M. Ferrero et al.	Studies of the acceptor removal mechanism in UFSD irradiated with neutrons and protons

# 11.4: UCLouvain CRC

## Irradiations

- 8 projects finished (10 foreseen)

Acronym	Experiment	Users	Irrad	Institute
AIDA-2020-CRC-2015-01	ALICE ITS	2	11.5 h	CERN
AIDA-2020-CRC-2016-01	ATLAS calo ASIC	2	6.5 h	Columbia Univ.
AIDA-2020-CRC-2016-02	LHCb FPGA RICH	5	10.0 h	IFIN-HH
AIDA-2020-CRC-2016-03	LHCb CLARO	3	8.0 h	INFN
AIDA-2020-CRC-2016-04	LHCb calor	6	13.0 h	CNRS/Barcelona
AIDA-2020-CRC-2017-01	CMS tracker	3	12.0 h	Imperial College
AIDA-2020-CRC-2017-02	LHCb CLARO	3	8.0 h	INFN
AIDA-2020-CRC-2017-03	ATLAS Pixel	3	11.0 h	Wuppertal

- 1 project submitted but not eligible.
- 27 users
  - ▶ 23 male 4 female
  - ▶ 9 institutes, 10 nationalities
- 80h/80h used

# 11.4: UCLouvain CRC

## AIDA2020 Year 5 at UCLouvain

- Irradiation hours exhausted almost two years ago
  - ▶ AIDA2020 users may profit for a reduced cost
  - ▶ Minimal cost: Electricity, Maintenance, ...
  - ▶ Depending on the project the cost may be different.
- 20 AU were available for AIDA2020. 2 irradiations performed:
  - ▶ One was a continuation of a previous project and used the single AU it remained .
  - ▶ One was an irradiation for CMS. Privileged access because a local group were close collaborators.
  - ▶ None of them passed through AIDA2020 selection process, although they considered as AIDA2020 projects in term of support.
- Several users desisted because of the cost.



# 11.5: UoB MC40 Cyclotron

## UoB overview

	Total number of projects	Total number of users	Total number of access units
Planned	60	180	240
Delivered	13	41	294.5



# 11.5: UoB MC40 Cyclotron

## Projects, users, unit access

Projects	Users	Unit access	Application
AIDA-2020-UoB-2015-02	5	39	ATLAS
AIDA-2020-UoB-2016-01	1	14	ATLAS
AIDA-2020-UoB-2016-02	2	7	ATLAS
AIDA-2020-UoB-2016-03	2	28	ATLAS
AIDA-2020-UoB-2016-04	4	59.5	ATLAS
AIDA-2020-UoB-2017-01	5	28.5	ATLAS (non-EU)
AIDA-2020-UoB-2017-02	2	68.25	<u>LHCb</u>
AIDA-2020-UoB-2017-03	2	16.5	HEP generic R&D (CMOS Sensors)
AIDA-2020-UoB-2017-04	7	4	HEP generic R&D (CMOS Sensors)
AIDA-2020-UoB-2017-05	5	4.5	<u>LHCb</u>
AIDA-2020-UoB-2018-01	3	7.5	Fast neutron detectors
AIDA-2020-UoB-2018-02	1	10.75	ATLAS
AIDA-2020-UoB-2019-01	2	7	EIC (non-EU)

## Summary

- The University of Birmingham delivered more UA than planned (294.5 vs 240), despite the number of projects and users is smaller than the allocated one
- 12% of beam time allocated to non-EU projects
- 34% of all supported users were female

